THE ACCEPTANCE OF EVOLUTIONARY THEORY BY SCIENCE TEACHERS IN THE FAIRBANKS NORTHSTAR BOROUGH SCHOOL DISTRICT, FAIRBANKS, ALASKA

By

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School of Education Graduate Program

APPROVED:

Eric Madsen, Dean, School of Education

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A

THESIS

Presented to the Faculty

of the University of Alaska Fairbanks

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MASTER OF EDUCATION

By

Peter Matthew Shier, B. S.

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ABSTRACT

This study measured the acceptance of evolutionary theory by science teachers in an Alaskan urban city. Acceptance was assessed by a sample of 59 high school science teachers through use of the Measure of Acceptance of the Theory of Evolution (MATE) instrument. This was incorporated into a booklet, which included survey items about teacher experience, education, and classroom practices. Descriptive statistics indicated the majority of teachers have an extensive amount of academic and classroom experience and a high level of acceptance of evolution. Assumptions about these characteristics correlating with an adequate treatment of evolution in the classroom were not confirmed when ~60% of teachers reported spending two weeks or less on evolution in class. Further research is needed to clarify the factors influencing the teaching of evolution in this school district.

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The submission of this thesis for review (almost) completes a long and interesting journey. Complex efforts commonly require the assistance and support of many people working together and this has been no exception. This researcher would like to sincerely and deeply thank the following people for their help, without which this thesis would not exist.

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1. INTRODUCTION

The theory of evolution has been a source of debate since it was first published as a part of the *Origin of Species* by Charles Darwin almost 150 years ago. Darwin's achievement was unique in that his theory was an explanation of natural phenomena in terms of nature, not in terms of God's purposes for nature. Also, it was a remarkable event in that the theory served as a unifying paradigm for all of the seemingly unrelated observations made as a part of natural history. The debate between creation and evolution began, in part, as a result of the inability of some people who were unable to appreciate Darwin's insight and still believe in God as creator. Today, these differences of world-view still keep some people from finding common ground on the subject of explanations for the origin and diversity of life on Earth.

Pressure coming from outside the science classroom to include theories alternative to evolution can adversely effect the teaching of evolution. Previous attempts to study this effect have produced results that may be incomplete or confounded by the inclusion of variables that are not directly related to a teacher's acceptance of evolution (Rutledge & Warden, 1999). Knowing the level to which evolution is accepted by teachers as a valid explanation of the origins and diversity of life on Earth is a crucial first step to understanding the effects of the debate between creation and evolution on the quality of science education in schools.

This thesis is a report on a quantitative-descriptive research study of the acceptance of evolutionary theory by science teachers in the Fairbanks Northstar Borough School District (FNSBSD) in Fairbanks, Alaska. This study was based on the work of Rutledge and Warden (1999) and used their Measure of Acceptance of the Theory of Evolution (MATE) instrument to assess the level of acceptance of the theory of evolution by the science teachers of the FNSBSD. It used a quantitative descriptive approach employing the MATE and categorical survey items to describe the characteristics of the teachers in the FNSBSD and their overall level of acceptance of evolution. Qualitative data were gathered through optional, voluntary responses to an open-ended prompt for "comments and concerns" about the study in particular and the effects of the debate in general.

2. REVIEW OF THE LITERATURE

2.1 Historical Literature

Creationism became a unique part of the United States culture in the early Twentieth Century. In the period following World War I, theologically conservative Protestants had splintered into many sub-groups. One group followed a "back-to-basics" credo and called themselves "Fundamentalists" to emphasize their literal adherence to the tenets of Biblical Christianity. This included a strong belief in the infallibility of scripture, a belief that the miracles described in the Old Testament actually occurred, and the trustworthiness of end-time predictions written in the New Testament (Larson, 2004; Roelfs, 1987).

The 1920's witnessed a popular yearning for the "good-old-days" prior to World War I. This included a renewal of faith, much like the one witnessed in the United States after the September 11th terrorist attacks. A prime target for public concern was the relatively new theory of evolution, which at that time was only 60 years old and still poorly understood by the majority of people. For the uninitiated, evolution claimed humans rose from savagery to enlightenment on their own without help from God and was in direct opposition to the account of creation as written in the Book of Genesis. This removed a need for God from society, as well as a need for salvation through personal faith in Jesus. A rudimentary understanding of the nature of science caused many creationist thinkers to encourage others to wait for proof of evolution through direct observation (Larson 2004, p. 203). This movement saw a peak when mounting concerns of these evangelical Chris-

tians nationwide were directed against the use of public tax dollars to teach a theory that was contrary to popular belief.

No national law was ever passed either for or against evolution in education during those years and each locality was allowed to chart their own course. One of the first successful anti-evolution laws passed in Tennessee in January of 1925 made it a misdemeanor offense to teach evolution. The American Civil Liberties Union (ACLU) was eager to challenge the law with a test case. The result came to be known as the "Scopes Monkey Trial" in which a substitute teacher, John Scopes, volunteered to serve as a "guinea pig" to see if the law would be upheld during a trial held in July of 1925. The litigators, Clarence Darrow and William Jennings Bryan, became the stars of one of the most famous trials in American history.

The debate continues to occupy the courts and the news as recently as December of 2005. Many of the news stories covering the most recent legal battle over evolution education in Dover, Pennsylvania mention Scopes, referring to the new trial as "Scopes II." Larson (2004) speculates in his account of the Scopes trial that the purpose was not to overturn the law (Scopes was found guilty and fined), but instead to publicly debate the logic of the creationist argument against evolution.

The aftermath of Scopes left the academic and education communities with little direction or support. The lack of a national law regarding evolution in education led to a hodgepodge of state and local restrictions against teaching evolution. This, coupled with the heightened sensitivity of some parents, led to "the origin of life" as an academic sub-

ject being ignored by textbook publishers and many individual teachers (Larson, 2004; Skoog, 1978, 1979).

This situation would remain virtually unchanged until the 1950's and 60's. During this time, advances in scientific knowledge (especially in genetics) and method would re-make "Darwinian" evolution into the Neo-Darwinian Modern Synthesis. In addition, the Soviet Union would initiate the space race by launching Sputnik and the United States would land a man on the moon. This, coupled with the centennial celebration of the publishing of *Origin of Species* in 1959, marked a renewal of faith in science and in the ability of humankind to complete any task to which they set their mind. Fresh concerns about United States preparedness to compete with other countries in this new world raised fears about the quality of the education being offered, particularly in science (Affannato, 1986; Bybee, 2001; Larson 2004; Troost, 1966).

The creationist response to this was a renewed emphasis on the inerrancy of scripture through literal readings and interpretations of *Genesis*. The Institute for Creation Research (ICR) was founded in 1970 by hydraulics engineer Henry M. Morris in response to the wild popularity in some demographics of his book *Genesis Flood.* ICR is credited with originating the doctrine of "Scientific Creationism"- essentially the Intelligent Design (ID) movement of the 1970's and 80's. The efforts of ICR members during this time represent the first recorded attempt to place creationism and evolution on equal footing in areas of science and philosophy (Alters & Alters, 2001).

Supporters of this new doctrine felt the so-called scientific nature of scientific creationism required that it be taught in the classroom alongside evolution. These efforts manifested themselves as legislative measures calling for the "balanced-treatment" of evolution and creation in the classroom and required that an equal amount of instructional time and effort be spent on each. Supporters advocated this position through negative attacks on evolution that attempted to poke holes in Darwin's theory by citing a lack of evidence, the improbability of the cumulative effect of genetic mutations, and the inability to prove evolutionary change through direct observation. As with Scopes, the ACLU frequently sought to test these measures in court. The "balanced-treatment" movement was finally outlawed in the federal Supreme Court with *Edwards v. Aguillard* in 1987 (Larson, 2004; Gould, 1999).

2.2 Theoretical Literature

The literature identifies the Intelligent Design (ID) movement as the current efforts of supporters of creationist thought to change science curriculum in the United States (Alters & Alters, 2001; Pennock, 2000). It is for this reason the historical effects of Intelligent Design movement as well as the philosophical underpinnings of Intelligent Design are considered as part of the section on theoretical literature.

A law professor named Phillip Johnson is credited with developing the first ideas associated with the genesis of the Intelligent Design movement. The reported goal of the movement is to search for empirical evidence that answers the question of life's origins by finding empirical evidence that proves the existence of an intelligent designer/creator

of the universe (Alters & Alters 2001; Pennock, 2000). Johnson first clarified his ideas in his book *Darwin on Trial* (1995) in which he expresses incredulity about the ability of evolution to adequately explain the origins and diversity of life on Earth. Johnson has difficulty with the theory of evolution as originally published in 1859, and states in the beginning of *Darwin on Trial* that he is uninterested in the advances and refinements that have been made in evolutionary theory in the 147 years since Darwin's *Origin of Species* was first published.

Johnson's ideas have been further developed, refined and expanded upon by other thinkers that have joined the movement. Like Johnson, their efforts are directed at undermining the claims made by evolutionary theory, but with a focus on undermining claims made by supporters of the theory of evolution: philosophical arguments made by Darwin, speculations on life's origins, and development of complex organs such as the vertebrate eye (Behe, 1996, Dembski, 2002; Meyer, 2004).

Johnson clarifies his view on the issue in his "Position Paper on Darwinism" (2003), in which he writes: "The important debate is not between "evolutionists" and "creationists," but between Darwinists (i.e., scientific materialists) and persons who believe that purely naturalistic or materialistic processes may not be adequate to account for the origin and development of life."

As mentioned earlier, Christian fundamentalist groups follow a conservative, literalist interpretation of the Bible, particularly with regard to the stories of creation as told in *Genesis* (Alters and Alters, 2001; Scott, 2001). The stereotypical account of a crea-

tionist view of creation and evolution is a dichotomy: Either evolution is true and the Bible is a collection of myths and legends, or the Bible is true and the empirical evidence supporting the many facets of evolution and the age of the Earth are false. It is important to understand that implicit with creationist belief in the veracity of Old Testament Bible accounts is the assurance of life after death in Heaven where we will spend eternity with our loved ones as told in the Gospels. The literature makes it clear that for the creationist, faith in the promises of the Gospels requires belief in the Old Testament stories of Genesis and The Flood.

2.3 The Creation/Evolution Continuum.

The "either-or" view of creation or evolution is logically untenable for many due to the large body of scientific evidence supporting an ancient earth and descent of animals with modification or changes in successive generations. Some researchers of the debate between creation and evolution find instead this causes many variations and gradations of the creationist theme (Alters & Alters, 2001; Pennock, 2000).

Table 1 offers a summary of general beliefs regarding the origin and diversity of life on Earth. They are arranged in approximate order by degree of dependence on the writings in the Old Testament from the Christian Bible, including belief in a "creation event" at which point the natural laws of the universe were suspended and the world came in to being. The table begins by listing Geocentrism, which follows a strict reading of *Genesis* and places the earth at the center of the solar system. The sun is relegated to a position equal to the other lights fixed in the vault of the heavens. Gocentrism and

Young-Earth Creationism (YEC) are similar in that they both agree creation events as told in *Genesis* are historically accurate and happened approximately 10,000 years ago. Old-Earth Creationism departs from this belief. Creation still occurs, but variations allow for explanations that incorporate some of the evidence supporting evolution.

Table 1

Summary of Philosophical and Epistemological Beliefs Regarding the Origin and Diversity of Life on Earth

Common Name	Causation	Belief(s)
Geocentrism	supernatural	-Biblical Genesis is historical truth -Earth at center of solar system
Young-Earth Creationism	supernatural	-Biblical Genesis is historical truth
Old-Earth Creationism	supernatural	-Creation occurred, but allows for vast age of Earth and fossils
Theistic Evolution	supernatural	-Evolution fully accepted -God creates using natural laws
Materialistic Evolution	material	-Evolution fully accepted -Material world all that exists

Note. This table is a summary of text from pp. 57-67 of: Scott, E. (2004) Evolutionism vs. creationism: An introduction. Berkeley, CA: University of California Press.

It is important to note that implicit with much of creationism is a reliance on supernatural causation (a belief that the supernatural causes things to happen in the natural

world) and are thus theistic in nature. The creationism supported by theistic evolutionists is very different from those previously mentioned. God still creates, but not miraculously through the suspension of natural laws. Instead, God creates in a way that may be indistinguishable from nature. Intelligent Design theorists work to find evidence of God's interaction with creation, while others are unconcerned with proof and allow for the peaceful co-existence of the evidence of science and the moral lessons recorded in the Bible.

Materialistic evolution (also known as "Darwinism" or "Metaphysical Naturalism") is like theistic evolution in that it accepts all evidence that supports the theory. As a belief system, it differs from all others previously mentioned in that it is by nature atheistic. The philosophy rejects belief in the supernatural and supports explanations that rely on natural causation exclusively. Adjectives such as "materialistic," "naturalistic" and "Darwinist" describe this belief in the creationist literature.

The worldview occupied by science is absent from the above table. The literature explains why the inclusion of science in a discussion of philosophy is inappropriate. Science has goals that are different from those of philosophy. Differences in epistemological beliefs are discussed in the next section.

2.4 Epistemology and Philosophy.

There is a fundamental difference between religion and science as a way of finding out about the world which creationist authors seem to either ignore or be unaware of. Scott (2001) explains the difference between *metaphysical naturalism* (MPN) and the method of science, *methodological naturalism* (MN), by reminding the reader that, like a theistic religion, MPN "...relies on science and is inspired by science, but it differs from science in being concerned with rules of conduct, ethics and morals" (p. 67). MPN is classified as a belief system because it is concerned with ultimate purpose and meaning.

Science (or MN) as a way of knowing can make no authoritative statements on these issues, but instead attempts to explain the natural world in terms of observable, testable nature. It can say nothing about ultimate meaning or purpose. Science does not seek to explain why, but instead explains how something happens.

Science and religion are very different epistemologies that cannot make authoritative statements about one another. Gould (1999) suggests a peaceful co-existence in which the two sides of the creation/evolution debate agree to not intrude on one another's areas of expertise. I feel this is appropriate in light of the nature of science as defined earlier - science cannot make conclusions about the supernatural because the supernatural cannot be measured in terms of the natural, which are the only tools science has available. This is the purpose of Methodological Naturalism - to explain the natural world in terms of nature.

Some authors maintain science as practiced by professionals is a methodology and not a philosophy (Alters and Alters, 2001; Moore, 1993). Philosopher Robert Pennock has written extensively on the nature of science and its relationship with religion: "Science as it is understood by practicing scientists is not so much a list of conclusions as it is a set of methods for investigating the physical world and thereby adding or revising conclusions" (2005, p. 3). In this way, God and the supernatural are removed from the explanation. Removed, because any supernatural elements that may be at work by definition exist outside of nature and are therefore unknowable through naturalistic methodology. Science cannot take an opinion for God (theism) or against God (atheism) because it is non-theistic (Smith, Siegel, and McInerney, 1995).

Gould discusses the epistemological roles of religion and science as "domains of ethical and factual inquiry" (1999, p. 58), emphasizing the inappropriate nature of any overlap between the two domains. There is reason to believe, however, that some creationist thinkers feel that an overlap is appropriate from a desire to apply the wisdom found in scripture to all areas of life.

In addition, confusion may also arise from a failure (or reluctance) to distinguish between MPN as a religious or philosophical belief and support of an MN view, which is unconcerned with ethics and philosophy. Alters and Alters (2001) speculate this is due to a creationist belief that accepting a scientific MN view of the world automatically leads to a God-less MPN view in which there is no possibility of the supernatural, and thus, no need to make a distinction.

Creationist opposition to *naturalistic* or *materialistic* evolution as a part of MPN (Alters & Alters, 2001; Johnson, 1995) arises from the fact that MPN excludes the possibility of the supernatural, while religion relies on belief in the supernatural to explain the natural world (Alters & Alters, 2001; Scott, 2004).

2.5 The Effect On Curriculum and Teachers.

As we have seen, the debate between supporters of evolution and creation is an extremely deep, complex issue encompassing areas of science and philosophy most laypeople, science teachers and even scientists do not fully understand or even grasp. My own inquiry began in an effort to comprehend the roots of the contention. The issue was finally made clear to me when I discovered an excerpt from a position paper on Darwinism written 5 years before *Darwin on Trial* by the same author, Phillip Johnson, was published. Johnson (2003) writes: "The important debate is not between "evolutionists" and "creationists" but between Darwinists (i.e., scientific materialists) and persons who believe that purely naturalistic or materialistic processes may not be adequate to account for the origin and development of life" (p.4). This makes it clear where the problem lies, at least for Johnson. The difficulty is not with evolution as a theory that explains the diversity of life on earth, but instead with people who maintain that God is not and cannot be part of the picture of life's origins because He does not exist. This is a problem for individuals and groups concerned with secondary science curriculum who may assume that all science teachers are scientific materialists (i. e., adherents of MPN).

Do people perceive teachers as being Darwinists? If so, this would place teachers in the cross-hairs of fundamentalist groups. I can easily imagine a situation in which a teacher with a strong personal faith might be mistaken for a scientific materialist. The literature reports how some teachers de-emphasize or avoid evolution in the classroom for fear of becoming a target (Affanato, 1986; Osif, 1997; Shankar & Skoog, 1993; Tatina, 1989; Van Koevering & Stiehl, 1989; Weld & McNew, 1999). This avoidance reaction may cause teachers to forcefully quash any discussion of evolution or other theories.

The creation/evolution dispute has had a documented effect on the personal beliefs of teachers, the curricula available for use in the classroom, and the curricular decisions they make based on where curricular content and personal belief intersect. One of the primary resources used by teachers in making curricular decisions is the textbook (Carlesen, 1990; Moore 2001; Skoog, 2005). In deference to this fact, Skoog analyzed 93 textbooks published between 1900 and 1977 to determine the manner in which evolutionary theory and its related subjects (zoology, geology, ecology, etc.) have been treated in secondary science textbooks. Textbooks were analyzed for word counts as general indicators of emphasis and trends. Overall, Skoog found a consistent and long-term trend from 1900 to 1977 in the number of words devoted to evolution in textbooks. Skoog also found that the strength of the statements concerning the central role evolutionary theory plays in understanding the natural world have been lessened as well. Skoog includes examples in which strong, affirmative language in support of evolutionary theory have been

softened or removed altogether in subsequent editions of textbooks published during the 20th Century. This fact is attributed to the influences of anti-evolutionist groups (Skoog, 1978, 1979).

Research also reveals that many biology teachers are poorly prepared to teach content and skills related to evolution, natural selection, and the nature of science. Many teachers in these studies had little or no formal instruction in evolutionary theory as pre-service teachers or as part of their undergraduate work. In addition, some teachers may not have had a sufficient number of credit hours in undergraduate biology classes (Moore, 2001; Smith, Siegel & McInerney, 1995; Tatina, 1989).

Pre-service science teachers may be pre-disposed to having difficulty in learning topics involving evolutionary theory. Bishop and Anderson (1990) used a pre-test/post-test method of ascertaining the beliefs of participants in an undergraduate class on evolution and natural selection. The test asked questions regarding whether or not the respondent accepted evolution as a valid explanation for the origins of life and was administered before the class began, and again at the end. The anticipated increase in the acceptance group at the end of the course did not come from both the creationist-minded students and the undecided group, but from the undecided group alone. The percentage of participants that did not accept evolution at the beginning of the course remained the same. This and similar research may indicate strongly held beliefs learned early in life are not easily changed. Brumby (1984) identified that these pre-existing beliefs can act as a barrier to new learning.

Biology teachers may be inadequately prepared by their undergraduate studies or teacher training to give evolution the treatment in the classroom the literature suggests is necessary. Smith, et. al. (1995) explains how science teachers are taught the central role evolution plays in biology, "but the available literature provides little practical guidance as to how evolution can be effectively taught...the classroom teacher is therefore left in the unenviable position of attempting to sort out the morass of issues involved on the basis of an often limited training in philosophy and epistemology" (p. 23).

Inadequate training of teachers in subject matter can adversely affect student learning. Carlesen (1990) explains how teacher subject matter knowledge can have a significant impact on classroom discourse and learning. His research shows how teachers exert a level of control over what is said and how questions are asked and answered depending on the comfort level the teacher has with the material. In general, students are allowed more freedom to explore ideas in classroom discussion and synthesis new contexts on their own if the teacher feels competent enough to lead them back if they stray. Ill-prepared teachers commonly limit classroom discourse by changing questions from an open-ended format to "yes-or-no" format with the teacher doing most of the talking. Carlesen believes this is an effort by the teacher to keep students from discovering gaps in the teacher's knowledge. It is likely the requirement under the "No Child Left Behind" (NCLB) Act that all teachers be federally highly qualified in their subject area will help ameliorate the problem of poor subject preparation of new teachers. However, it is still

possible some preparation programs may be unconcerned as to whether or not a pre-service science teacher has attended courses in evolution and the nature of science.

The problem of apparent inadequacies in teacher training may result from a lack of good models to follow or curricula that gives evolution a central role. Given past and present opposition to the production of materials that treat evolution properly, teachers may have to wait some time before this need is filled.

2.6 Studies Measuring Teacher Acceptance.

Several studies of secondary science teachers and the role evolution plays in their classroom have been conducted in the United States. This body of research seeks to explain and compare a multitude of aspects of the life of a teacher: religious beliefs, opinion of whether scientists accept evolution, teacher opinion of the role of creationism in the classroom, teacher attitudes and opinions, and teacher acceptance of evolution. I will concentrate on what these studies have to offer regarding teacher acceptance.

The literature show that most teachers (approximately 2/3 of sampled groups in several states) agree evolution is a central, unifying theme of biology and place a moderate to strong emphasis on evolution in the classroom. The remaining 1/3 do not agree, and feel instead there is a role for creation in the classroom. In most cases, teachers in this group include creation out of a perceived need for fairness, to serve as an example of "bad" science, or due to a sincere belief in creation as a valid explanation for the origins of life (Affanato, 1986; Osif, 1997; Shankar & Skoog, 1993; Tatina, 1989; Van Koevering & Stiehl, 1989; Weld & McNew, 1999).

Historically, the de-emphasis of evolution has had effects on the education of teachers. Research conducted by Affannato (1986) shows a large percentage of biology teachers fail to appreciate the central role that evolutionary theory should occupy in the science classroom, even though acceptance of evolutionary theory is present. This may be due, in part, to the tendency for teachers to teach in a manner similar to the way they were taught. The historical de-emphasis of evolution in biology classes may result in teachers delivering biology content as a collection of facts without the glue of evolution to hold it together in a coherent, understandable picture. Also, teachers that offer evolution and creation-science as "equally scientific explanations" may not have a complete grasp of the nature of science (NOS). This may result from deficiencies in secondary science education, post-secondary science education, or both.

Tatina (1989) speculates evolution is not central in the biology classroom for four basic reasons: a) Evolution is a complex topic that is challenging to teach and learn. Teachers avoid it because they are not comfortable with the subject or feel it will be too challenging for their students to master. b) Evolution is not included in teacher curricular decisions because it is not believed. c) Evolution is not universal in high school science because it offends religious beliefs, and d) There is no pressure to include it (pp. 278-279).

Teachers (and students) may face further challenges in learning and accepting evolution as a valid explanation of the origins and diversity of life because of the nature of the discipline. Evolutionary biology is a sub-discipline of biology that relies on gather-

ing historical evidence to support its claims. Inferences about the biology of extinct life-forms are made based on this evidence. The huge amounts of time required for significant evolutionary change preclude any real-time, direct observation. This method of investigation departs from the way in which most people learn science is "done" while in high school science class. Students frequently learn science by performing an experiment that is frequently completed before the class period is over. The results are filled out in a worksheet and leading questions are answered on the provided handout (Rudolph and Stewart, 1998).

2.7 Solutions for Researchers.

As mentioned previously, several studies of secondary science teachers have tried to explain and compare a multitude of aspects of the life of a teacher: religious beliefs, opinion of whether scientists accept evolution, opinion of the role of creationism in the classroom, attitudes and opinions of the debate in general, and overall acceptance of evolution.

Researchers Rutledge and Warden (1999, 2000) attempt to simplify the issues previous studies have attempted to assess by focusing their research instead on just the level to which teachers accept evolution as a valid explanation for the origin and diversity of life on Earth. The authors were concerned the number of questions required in a survey to address numerous issues would make an instrument so convoluted and long so as to produce incomplete or confounded results. For example, study participants could become tired or frustrated by an time-consuming questionnaire.

The goal of the initial work performed by Rutledge and Warden was to develop and validate an instrument for accurately assessing the level of acceptance of the theory of evolution by secondary biology teachers. The authors developed a new instrument called the Measure of Acceptance of the Theory of Evolution (MATE). The MATE generates an acceptance score based on Likert-scale responses to statements of fundamental concepts of evolutionary theory and the nature of science. It was tested and found reliable with a 53% rate of response among the high school biology teachers of Indiana. The MATE assesses acceptance of evolution and gives a starting point to adequately assess other areas, such as the level of understanding of science content, or the effect of religious affiliation on teacher curricular decisions.

2.8 Considerations for Alaska Research.

Science literacy is becoming an area of focus in education. Recent trends in education following the implementation of the No Child Left Behind (NCLB) act require an increased emphasis on standards-based instruction by federally highly qualified teachers and high-stakes testing to determine "adequate yearly progress" (AYP) of schools and their students.

Standards remain a key area of confusion as teachers and school districts work to implement the requirements of NCLB. The literature has shown an historical tendency of individuals and groups engaged in attempts to subvert science education by removing or weakening the treatment of evolution in state science education standards (Alters & Alters, 2001; Moore, 2004). However, a recent nationwide study of state science standards

revealed a renewed focus on evolution. This study indicates that the study of evolution will be emphasized in the nation's schools in an unprecedented manner in the near future (Skoog and Bilica, 2002). It remains to be seen if this renewed focus reflects a change in public opinion sufficient to empower teachers to enact the required changes in a confident and decisive manner. I believe this disconnect remains due to a poor understanding of the issues discussed earlier with regard to the differences between the rule of science (MN) and materialist, naturalist philosophy (MPN) opposed by creationists. This is of particular concern in light of the aforementioned literature regarding teacher understanding and support of evolution due to personal background and aspects of issues in teacher preparation.

Alaska students currently exhibit academic competency through completing the High School Qualifying Exam (HSGQE). Adequate yearly progress (AYP) under NCLB is determined using student scores from HSGQE data (Alaska Department of Education & Early Development, 2006). A news release made public by the Alaska Department of Education & Early Development in August of 2005 reports the overall level of AYP achievement of Alaska's schools for 2004-05, in which 59% of schools statewide made AYP and 41% did not make AYP (Alaska Department of Education & Early Development, 2005). Science will join reading, writing and math as part of the HSGQE in 2008. This seems appropriate when one considers that students learn science content and principles through reading, writing and math. A clear understanding of what issues stand in

the way of student achievement in science can assist schools in determining what areas of instruction require improvement to stay in compliance with the requirements of NCLB.

The review of the literature revealed many studies of the issues surrounding the debate between evolution and creation in the classroom and its effects on education. A survey of the literature revealed no work on this issue completed in the state of Alaska. Alaska is unique in its relationship to the rest of the United States due in part to its geographic location, its population density, and ethnic makeup. Research in to the perceptions and attitudes of teachers in communities as diverse as a major urban center or a tiny native village are vital. An approach to research focusing on the avoidance of potential confounders when studying the acceptance of evolution by science teachers similar to the work completed by Rutledge and Warden is an important consideration.

2.9 Conclusion

Researchers who study the educational aspects of the debate between creation and evolution report the varied effects that have resulted in curriculum, science literacy, teacher performance and teacher preparation. Many admit more research needs to be done to continue monitoring of curricular materials to ensure alignment to standards. Assessment of student proficiency in subject areas can help reveal the effectiveness of teachers and the curricular decisions being made in the classroom. If previous studies are an indication, many teachers need clarification about the nature of science and the differences it exhibits when compared to religion as a way of knowing.

The importance of producing students that are scientifically literate is a vital issue to the future of a technologically dependent society. The central role played by the teacher in the classroom requires that a clearer idea of what mental/professional/ developmental package the science teacher brings to the classroom could be useful in designing future research, pre-service teacher training, and professional development opportunities. Research similar to that of Rutledge and Warden that seeks to simplify the the numerous issues involved in the convoluted debate between evolution and creation appears to be a good direction from which to approach future research.

3. STATEMENT OF THE PROBLEM

3.1 Societal Problem

As we have seen above, the dispute between creation and evolution is a long one that has been going on for many years. The dispute between evolution and creation manifests itself on a societal level as groups and individuals try to answer the question of origins in epistemological terms in the public arena - the courtrooms and classrooms of the United States.

The literature explains how people can be seen as knowing about the world through lenses (epistemologies). We use these epistemological lenses to give the world meaning and purpose, whether we are creating music or playing baseball. We speak about the quality of a musical piece in terms of musical appreciation. We interpret the fairness of a play in baseball in terms of baseball rather than by using the rules of a different sport. We understand and judge different aspects of the world by interchanging lenses as appropriate for different situations, like a trip to the store, or attending a concert at an opera house. Each lens gives each situation meaning and purpose.

Religion is an epistemology that attempts to explain the natural world in terms of the supernatural. Greek myths tried to explain the origin of pain and suffering in the world through the story of Pandora and her box. The Christian Bible offers a different explanation through the story of Genesis. Both of these stories explain the cause of a natural phenomena (in this case, pain) through supernatural explanations. This depend-

ence on the supernatural makes this epistemology theistic in nature. God(s) create the natural world for a purpose that gives all aspects of creation meaning. Religion answers the question of why things were created.

Metaphysical Naturalism (MPN) is an example of an epistemology that seeks to explain the world solely in terms of natural causes. The possibility of a cause originating outside of nature is not possible because in this view, the natural world is all that exists. There is no supernatural and so this epistemology is atheistic. Another word to describe this stance frequently used in the literature is materialistic or naturalistic. Nature creates the natural world for a purpose that gives all aspects of creation meaning. MPN answers the question of why things were created, too.

Methodological Naturalism (MN) is an example of an epistemology that seeks to explain the natural phenomena in terms of natural causes. MN is similar to MPN in their common purpose even though there is a difference between the two. MN observes, quantifies and explains the natural world in terms of nature. MN does not attempt to answer why. Instead, it attempts to answer how. Unlike religion and MPN, MN has no opinion on the supernatural and so is non-theistic. This is the lens commonly associated with the attempts of scientists to explain the world.

Disputes over situational interpretations can arise if individuals disagree about which lens is to be used in a certain situation. For example, it would be inappropriate to judge the merits of a play using the lens of sports. In the same way, disagreements about the appropriateness of using a religious lens where an MN lens might be more useful and

accurate when answering the question of "how" something happened are frequently the subject of skirmishes in the battle between creation and evolution.

The literature shows how the dispute between creation and evolution is due to a difference in opinion of which of the above lenses is to be used to answer the question of human origins. This is due in part to the central role scripture plays in fundamentalist circles. Marc Fey writes for a program that is part of Focus on the Family (itself a well known fundamentalist organization) called "The Truth Project." The purpose of the project is to assist believers in re-orienting themselves to a biblically based way of life in which all aspects of living are viewed through the lens of the Word of God. In the classroom, these people feel the explanation for the origin and diversity of life on Earth lies in the Bible and the stories written within. The explanation is given in terms of the supernatural.

Phillip Johnson clarifies the issue in his "Position Paper on Darwinism" (2003) where he writes: "The important debate is not between "evolutionists" and "creationists" but between Darwinists (i.e., scientific materialists) and persons who believe that purely naturalistic or materialistic processes may not be adequate to account for the origin and development of life" (p. 4).

This makes it clear where the problem lies, at least for Johnson. The difficulty is not with evolution as a theory that explains the diversity of life on earth, but instead with people who maintain that God is not and cannot be part of the picture of life's origins because He does not exist. This is a problem for individuals and groups concerned with

secondary science curriculum who may assume that all science teachers are scientific materialists (i. e., adherents of MPN).

The literature shows how in a public school, this explanation of the origins of life on earth is given in terms of natural causes. The supernatural is not considered. A person visiting the classroom on a day when origins are considered and the word "evolution" is used might hear a student ask about alternative origins theories that offer supernatural explanations. It is likely the teacher will handle the question skillfully. It is to be hoped the teacher will relate how supernatural explanations are not offered as a part of scientific investigation due to the fact that the supernatural is by definition outside of nature and thus unknowable by the tools science has available.

3.2 Professional Background

The literature describes how teachers are poorly prepared to handle the fallout from the debate in the classroom. One way in which the debate has affected the classroom is in textbooks and curricula. Research has shown how the Scopes trial has a lingering effect in this area more than 80 years after the final verdict was handed down. In general, the treatment of evolutionary theory in textbooks and curricula has faced an overall trend of de-emphasis. Evolution has been moved to the back chapters of texts were it is often not covered in the course of a semester due to a lack of time. The chapters about evolution have language that is softened and delivers arguments of philosophical points less rigorously than one might expect. For example, text referring to evidence

for evolution might say "The evidence seems to suggest..." rather than a more appropriate "The evidence strongly supports..." (Moore, 2001; Skoog, 1978, 1979, 2005).

Historically, the de-emphasis of evolution has had effects on the education of teachers. Research conducted by Affannato (1986) shows a large percentage of biology teachers fail to appreciate the central role that evolutionary theory should occupy in the science classroom, even though acceptance of evolutionary theory is present. This may be due, in part, to the tendency for teachers to teach in a manner similar to the way they were taught. The historical de-emphasis of evolution in biology classes may result in teachers delivering biology content as a collection of facts without the glue of evolution to hold it together in a coherent, understandable picture. Also, teachers that offer evolution and creation-science as "equally scientific explanations" may not have a complete grasp of the nature of science (NOS). This may result from deficiencies in secondary science education, post-secondary science education, or both.

3.3 Research Background

Research on the teaching of evolution in the public school classroom has been studied in many areas of the United States. This body of research, in general, seeks to study a multitude of aspects in the life of a teacher: religious beliefs, opinion of whether scientists accept evolution, teacher opinions of the role of creation in the classroom, attitudes, and degree to which evolution is accepted. These studies show that the majority of teachers (approximately 2/3 of those sampled in several states) agree evolution is a central, unifying theme of biology and place a moderate to strong emphasis on evolution in

the classroom. The remaining 1/3 differ from their colleagues in agreeing there is a role for creation in the classroom. In most cases, teachers in this group include creation in the classroom out of a perceived need for fairness, to serve as an example of "bad science", or due to a sincere belief in creation as a valid expression for the origins of life (Affanatto, 1986; Osif, 1997; Shankar & Skoog, 1993; Tatina, 1989; Van Koeveing & Stiehl, 1989; Weld & McNew, 1999).

Tatina (1989) speculates evolution is not central in the biology classroom for four basic reasons: a) Evolution is a complex topic that is challenging to teach and learn. Teachers avoid it because they are not comfortable with the subject or feel it will be too challenging for their students to master. b) Evolution is not included in teacher curricular decisions because it is not believed. c) Evolution is not universal in high school science because it offends religious beliefs, and d) There is no pressure to include it (pp. 278-279).

Through the above discussion we have seen there are a morass of issues to be sorted out regarding the debate between evolution and creation and the affect it has had on secondary science education. In addition to the considerations each educator must make with regard to individual curricular decisions made in the classroom, administrators must consider issues of personnel and student achievement when considering how to comply with all of the aspects of the No Child Left Behind (NCLB) Act. It is clear an accurate assessment of the factors affecting science education is necessary.

3.4 Problem Statement

The literature makes it clear there is a significant segment of the population of science teachers that feel there is a role for creationism in the classroom. Previous research has attempted to figure out why this is so, with limited success. Researchers Rutledge and Warden sought an alternative approach which gets to the heart of the matter: a teacher must accept evolution to be able to teach it effectively.

These researchers approached the problem of determining the state of mind of a teacher by removing what they view as confounders present in other studies. Issues such as religion, creationism, teaching, and fairness should be removed from consideration, at least initially. The focus of their research was to determine the degree or level to which a teacher accepted the theory of evolution as a valid explanation for the origins and diversity of life on Earth. Once this factor was a known quantity, other factors (such as religious affiliation) can be introduced in order to study how the factors are related.

3.5 Professional Significance

The ability of evolution to explain seemingly unconnected observations and unify sciences such as medicine, paleontology, geology and zoology has prompted many scientific and educational institutions to issue policy statements regarding the teaching of evolution in classrooms. They encourage educators to treat biology in classrooms in a manner reflecting the central unifying nature of evolution. Ideally, evolution should underlie all content during the course of study. New knowledge should be contextualized within evolutionary theory. Students should be able to use their understanding of evolution to

synthesize their own connections and explanations under the careful guidance of their teacher.

Many professional organizations also universally recommend the avoidance of all "non-scientific" explanations for the origin of life. The statements all adhere to a belief evolution is a statement of such unifying and explanatory power that theories supporting beliefs that cannot be examined through the methods of science should not be in an already overcrowded curriculum (American Geological Institute, 1981; American Geophysical Union, 1981; Geological Society of America, 2001; Georgia Science Teachers Association, 2003; Michigan Citizens for Science, 2003; National association of Biology Teachers, 1995; National Science Teachers Association, 2003; Utah Science Teachers Association, 1990). Past studies suggest instruction in evolutionary biology at the high school level has been non-existent, of poor quality, or full of misinformation (Roelfs, 1987; Shankar & Skoog, 1993).

Science literacy is becoming an area of focus in education. Recent trends in education following the implementation of the No Child Left Behind (NCLB) act require an increased emphasis on standards-based instruction by federally highly qualified teachers and high-stakes testing to determine "adequate yearly progress" (AYP) of schools and their students.

Standards remain a key area of confusion as teachers and school districts work to implement the requirements of NCLB. The literature has shown an historical tendency of individuals and groups engaged in attempts to subvert science education by removing or

weakening the treatment of evolution in state science education standards (Alters & Alters, 2001; Moore, 2004). However, a recent nationwide study of state science standards revealed a renewed focus on evolution. This study indicates that the study of evolution will be emphasized in the nation's schools in an unprecedented manner in the near future (Skoog and Bilica, 2002). It remains to be seen if this renewed focus reflects a change in public opinion sufficient to empower teachers to enact the required changes in a confident and decisive manner. I believe this disconnect remains due to a poor understanding of the issues discussed earlier with regard to the differences between the rule of science (MN) and materialist, naturalist philosophy (MPN) opposed by creationists. This is of particular concern in light of the aforementioned literature regarding teacher understanding and support of evolution due to personal background and aspects of issues in teacher preparation.

Alaska students currently exhibit academic competency through completing the High School Qualifying Exam (HSGQE). Adequate yearly progress (AYP) under NCLB is determined using student scores from HSGQE data (Alaska Department of Education & Early Development, 2006). A news release made public by the Alaska Department of Education & Early Development in August of 2005 reports the overall level of AYP achievement of Alaska's schools for 2004-05, in which 59% of schools statewide made AYP and 41% did not make AYP (Alaska Department of Education & Early Development, 2005). Science will join reading, writing and math as part of the HSGQE in 2008. This seems appropriate when one considers that students learn science content and prin-

ciples through reading, writing and math. A clear understanding of what issues stand in the way of student achievement in science can assist schools in determining what areas of instruction require improvement to stay in compliance with the requirements of NCLB.

The review of the literature revealed many studies of the issues surrounding the debate between evolution and creation in the classroom and its effects on education. A survey of the literature revealed no work on this issue completed in the state of Alaska. Alaska is unique in its relationship to the rest of the United States due in part to its geographic location, its population density, and ethnic makeup. Research in to the perceptions and attitudes of teachers in communities as diverse as a major urban center or a tiny native village are vital. An approach to research focusing on the avoidance of potential confounders when studying the acceptance of evolution by science teachers similar to the work completed by Rutledge and Warden is an important consideration.

3.6 Delimitations of the Study

This paper describes a research study which examines teacher conceptions of evolution in a small town in interior Alaska. Relationships between teacher acceptance of evolution and academic background are also investigated. This topic was selected for various reasons. Four years of undergraduate study in biology and eight years experience teaching biology in public school have made me keenly aware of the ongoing conflict between science and religion over the theory of evolution and its place in the biology classroom. This dispute has been fought in various forms all over the United States since the 1920's. I am interested in uncovering whether the conflict has found its way to

Alaska and what effect it may have on proper science education in the Fairbanks North-star Borough School District.

The Fairbanks Northstar Borough School District (FNSBSD) is located almost in the geographic center of Alaska. It is very large, encompassing 7,361 square miles-which is roughly the size of Rhode Island, Delaware, and Connecticut combined. There are 32 schools in the district. Of those, 10 are secondary serving grades 7-12 in a "traditional education setting" one might find almost anywhere in the United States. The average number of students in an FNSBSD classroom is approximately 24 (Sundberg, 2005).

The FNSBSD also offers options to students with differing educational needs in the form of optional and alternative educational programs. These schools are quite small, where a handful of teachers serve a relatively small number of students. These schools employ a variety of methods to meet the needs and learning styles of students. Some schools do not have a teacher on staff with a certificate endorsement to teach science. These schools will not play a part in this investigation to maximize homogeneity and to minimize possible confounders.

Personal experience has shown biology education classes at the secondary level in the FNSBSD exemplify the setting in which students receive their first exposure to the theory of evolution and the concept of natural selection. This study proposes to assess the level of teacher acceptance of the theory and speculate on the effect this acceptance has on the depth of the overall science education in the district.

The geographic area encompassed by the FNSBSD is quite large, but the population is relatively small. There are only 10 secondary schools. The staff of these schools assigned to teach science districtwide represents a really small number compared to the number of science teachers one might find in a district in the lower 48 states. At the beginning of the study, 58 survey packages were sent through the mail to teachers assigned to teach science in secondary schools of the FNSBSD. The survey was mailed during the period of time between New Year's Eve and the end of the grading period before Spring Break to avoid non-completion of the survey because of respondents being too busy with holiday activities and report cards.

From the original group of 59 surveys sent out, 38 teachers elected to participate in the survey opportunity and returned surveys. This represents a return rate of 64.4%. 38 represents a small sample size, and may represent only the teachers that had a strong opinion to share.

It is possible that there are some characteristics of the FNSBSD teachers that limit the degree to which the results of this study can be applied to other populations in Alaska or elsewhere in the United States. Obviously, the sample size is quite small. Fairbanks, Alaska is the second largest city in Alaska and the main urban hub for an area covering several thousand square miles. Fairbanks is the home of the main campus of the University of Alaska. Fairbanks is one of the main branches of the university that offers a program for students to obtain their secondary liscensure for teaching in Alaska secondary schools. It is possible a significant number of the teachers in the FNSBSD obtained

their teaching certificates through the school of education at the University of Alaska in Fairbanks (UAF).

3.7 Organization of the Thesis

The remainder of this thesis is composed of a look at the methodology used to complete this study. This will include a description of the research site, the research participants, and the materials used - including the procedures followed and the data analyses made. This will be followed by an account of the results obtained, and a summary and discussion of the findings.

4. METHODOLOGY

4.1 The General Perspective

This study employs a quantitative descriptive research approach. It sought to accurately assess the level to which the secondary science teachers of the Fairbanks Northstar Borough School District accept the theory of evolution as a valid explanation of the origins and diversity of life on Earth. The Measure of Acceptance of the Theory of Evolution (MATE) instrument was developed by researchers Rutledge and Warden (1999) to accurately assess the acceptance of evolution. This instrument was included with categorical demographic survey items in a small booklet that was mailed to the home addresses of 59 science teachers in the Fairbanks Northstar Borough School District (FNSBSD) in Fairbanks, Alaska. Participants were provided with an option to express their comments and concerns about the study on the back side of the survey booklet.

4.2 The Research Context

The research took place in the homes of the secondary science teachers of the Fairbanks Northstar Borough School District. Initial access to the population was attempted through permission from the FNSBSD, but permission was not granted. As an alternative, teacher addresses were obtained by written request from the Alaska Department Early Education and Development in Juneau, Alaska. Home addresses of all certified teachers in the series of zip codes surrounding the Fairbanks area were requested.

This included all addresses of teachers certified to teach in the state of Alaska beginning with the numbers "997**."

4.3 The Research Participants

The research participants were teachers assigned to teach at least one section of science during the 2005-2006 school year. Evolution is commonly referred to as a sub-discipline of biology. Teachers of other branches of science in addition to biology were included as participants in this study. The literature supports inclusion of branches of science other than life sciences in an investigation such as this because evolution is a very broad topic which cuts across many scientific disciplines (Johnson, 1995).

The names of the research participants were obtained through the Program Planning and Evaluation office of the FNSBSD. A document containing the master schedule of teaching assignments for all of the schools in the FNSBSD was used to find the names of all teachers teaching at least one section of science. 59 total names were found to fit this criterion. The list of participants was matched with the list of addresses to find home addresses for just the science teachers.

4.4 Instruments Used

Rutledge and Warden (1999) analyzed previous studies attempting to understand the various factors involved in the effect of the dispute between evolution and creation on teachers. They determined these numerous studies conducted using different methods in various parts of the United States were flawed by the wide-ranging factors they attempted to include. Rutledge and Warden found a more effective approach would be to instead

determine the level to which a teacher accepted the theory of evolution and use that number as a basis to study the contributions of the other factors previously removed, such as religious affiliation, or years of experience, in subsequent research.

The survey instrument developed by Rutledge and Warden (1999) is called the "Measure of Acceptance of the Theory of Evolution" (MATE). The MATE instrument consists of 20 statements about evolution and the issues surrounding it accompanied by a Likert scale of choices ranging from "Strongly Disagree" to "Strongly Agree." The instrument produces a MATE score from 20 to 100. The lowest number represents a low level of acceptance and the highest number represents the highest level of acceptance. Numbers in the intermediate range (40 to 70) represent an intermediate level of acceptance.

The MATE score is determined by assigning numerical values to responses on the Likert scale like this: Strongly Disagree = 1, Disagree = 2, Undecided = 3, Agree = 4, Strongly Agree = 5. In this way, each of the 20 questions is worth a maximum of 5 points, with the entire 20 questions giving a maximum score of 100. One-half of the statements are worded in such a way so as to appear to support creation rather than evolution. These "reverse" statements are included to give the survey the appearance of a lack of bias toward either evolution or creation. Pro-creation statements were scored in "reverse," so that a response of "Strongly Agree" to these items would give a value of "1" rather than "5." Similarly, a response of "Strongly Disagree" to a statement in support of

creation would be assigned a value of "1." In this way the overall objective of measuring the respondent's support of evolution would be preserved.

The MATE instrument was chosen for simplicity and ease of use for the researcher as well as the respondent. The researchers that developed the MATE tried to keep it short and simple to guard against undue stress on the respondent, and perhaps increase the rate of return. The structure of the survey is also very simple and straightforward. The purpose is easy to understand and justify. This ease of use also benefits the researcher through the ease with which it is scored.

4.5 Procedures Followed

The names of the research participants were obtained through the Program Planning and Evaluation office of the FNSBSD. The report on class sizes from the Program Planning and Evaluation Department of the FNSBSD also gives subjects taught for teachers in the district's secondary schools. This report was used to find the names of all teachers teaching at least one section of science in secondary schools of the FNSBSD. Fifty-nine total names were found to fit this criterion.

The research took place in the homes of the secondary science teachers of the Fairbanks Northstar Borough School District. Initial access to the population was attempted through an application to the FNSBSD. An application for permission to conduct research in the FNSBSD submitted in the Spring of 2005 was denied. This may have been due to my poor judgement in placing a logo used by the FNSBSD on early versions of the contact material. This may have caused an incorrect assumption among members

of district administration and the survey respondents that the survey was somehow associated with the district.

As an alternative, teacher addresses were obtained by written request from the Alaska Department Early Education and Development in Juneau, Alaska. Home addresses of all certified teachers in the series of zip codes surrounding the Fairbanks area were requested. This included all addresses of teachers certified to teach in the state of Alaska beginning with the numbers "997**." The Alaska Department of Early Education and Development produced an Excel spreadsheet containing teacher first names, last names and mailing addresses for Fairbanks, Alaska and the zip codes of outlying areas. The list of participants was matched with the list of addresses to find home addresses for just the science teachers obtained above.

4.6 Survey Design and Implementation

The design of the survey implementation followed the recommendations of Dillman (2000). A multiple contact design was used to maximize the response rate. Three mailings were used. The first mailing consisted of a postcard with a brief note announcing the coming survey package and its purpose. The postcard utilized an unusual shape, size and color with the idea of increasing the likelihood it would be noticed and read by a respondent who probably receives a high volume of junk mail.

The second contact was the survey mailing itself. This arrived in an large manilla envelope and contained (in order): an introductory letter, the survey booklet and a pre-stamped, pre-addressed return envelope for returning the survey booklet, once completed.

The introductory letter was modeled from the letter used by Rutledge and Warden (1999) for the study in which the MATE instrument was first designed and field-tested. The letter explained the rationale and purpose of the survey, as well as guarantees the results were completely confidential. This included an assurance no part of the survey or accompanying stationery (envelopes, addresses, etc.) contained any means by which the respondent could be identified with any returned material. Also included was a short sentence explaining how this survey was being offered as part of the requirements for the completion of a Master of Education degree.

Paper-clipped behind the letter was the survey booklet, designed following the recommendations of Dillman (2000). The survey was composed of two parts: Part 1 was the MATE survey itself, and Part 2 had the questions asking for information about the respondent (years of experience, number of credit hours, etc.).

The survey was designed in such a way so as to form a small 4 1/4 by 5 1/2 inch booklet. Each "page" of the booklet used one-half of a sheet of standard 8 1/2 by 11 inch paper when printed in landscape form. When printed front to back, the entire survey booklet (MATE questions and demographic questions) could be printed on three sheets of paper, folded in half across the middle, and fixed with a staple on the "binding" to form the 6-page booklet. The blank space on the back of the booklet was used to write a short note of thanks, and to provide a small space in which to write down any questions, thoughts or concerns about the survey the respondent felt a need to share. Booklet printing was performed by the staff at the local Fed-Ex/Kinko's.

The final item in the survey mailing was a pre-stamped envelope chosen for a size that would neatly fit the survey booklet. The mail-merge capabilities of a computer software package were used to personalize all materials to the individual respondent. The survey mailing was followed one week later by the third contact postcard, similar in size, shape and color to the first contact card. This card contained a note thanking the respondent for their participation, and a gentle reminder for respondents that have not yet completed their survey to do so soon.

4.7 Quantitative Scoring

Rutledge and Warden (1999) provided the scoring guide and instructions in their first paper on the MATE instrument. The MATE produces a numerical value for each respondent indicative of the level to which evolution is accepted as a valid explanation of the origins and diversity of life on Earth. The MATE score is determined by assigning numerical values to responses on the Likert scale like this: Strongly Disagree = 1, Disagree = 2, Undecided = 3, Agree = 4, Strongly Agree = 5. In this way, each of the 20 questions is worth a maximum of 5 points, with the entire 20 questions giving a maximum score of 100.

The developers of the MATE took precautions against bias on the part of the respondent by ensuring respondents were not overwhelmed with survey items that were obviously in support of evolution. One-half of the statements were worded in such a way so as to appear to support creation rather than evolution. Pro-creation statements were scored in "reverse," so that a response of "Strongly Agree" to these items would give a

value of "1" rather than "5." Similarly, a response of "Strongly Disagree" to a statement in support of creation would be assigned a value of "1." In this way the overall objective of measuring the respondent's support of evolution would be preserved.

Categorical data from the demographic questions in Part 2 were scored in a fashion similar to the MATE by assigning numerical values to responses. For example, a survey item asking respondents to indicate the highest degree level attained offered these choices: a) Bachelor of Education (B. Ed.), b) Bachelor of Arts (B. A.), c) Bachelor of Science (B. S.), d) Master of Arts (M. A.), e) Master of Education (M. Ed.), f) Master of Science (M. S.), g) Doctor of Philosophy (Ph. D.), and h) Other. These eight choices were each assigned a numerical value from one to eight. Similarly, the choices for the item on gender were assigned a "1" for male and "2" for female. All data were scored from each survey and entered into a spreadsheet listed by a survey number assigned for scoring purposes. The overall MATE score consisted of the sum of the numerical values for the MATE items as calculated by the spreadsheet. A sub-set of these were hand-checked to ensure accuracy.

These data were exported from the spreadsheet as space-delimited text for importing in to SPSS version 11 for the Apple Macintosh computer. The user-interface of SPSS provides an easy, straightforward method for performing an analysis using descriptive statistics in the program. This command was used to produce values for the median MATE score, range, Pearson's measure of skewness, and the percentile ranks of the data. The mean was chosen as an accurate measure of central tendency for the MATE score

due to its resistance to the effects of outliers in data. The presence of a single outlier score that was significantly lower than the majority of the remaining scores made this choice necessary. SPSS also produced values for the mode of each variable.

4.8 Qualitative Scoring

The blank space left on the back of the survey for optional comments was used by about one-third of the respondents to record thoughts and concerns they had about the survey or the issues surrounding the debate. The comments written there included notes about their feelings on the debate between creation and evolution, their hopes for other teachers faced with this issue, and interest in obtaining a copy of the completed research. These were scored following the recommendations of Creswell (2005) regarding the scoring of qualitative data. Two general themes were assigned to the comments of the respondents: Attitude and Action. "Attitude" was intended to derive the overall attitude of the respondent as positive, negative or indifferent based on the tone of the comments and suggestions offered. "Action" was intended to inform on the type of action a respondent might take in response to the attitude toward the issue: proactive, frustrated, or neither. The comments of two respondents were limited to asking for copies of the completed research, and so were dropped from consideration in the qualitative database.

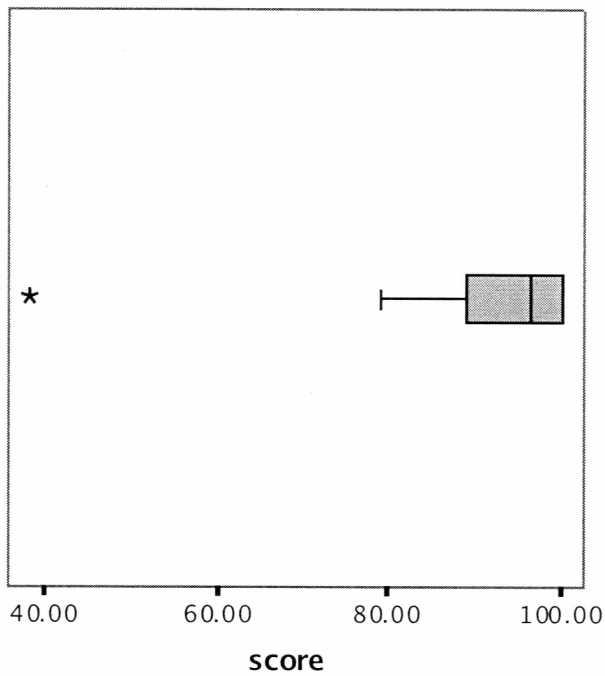
5. RESULTS OF THE STUDY

5.1 Numerical Results (MATE Score)

A total of fifty-nine surveys were mailed to science teachers in the FNSBSD. Thirty-eight of those were returned by individuals who elected to take part in the survey (n=38), for an overall return rate of 64.4%. The data for the numerical score generated by participants completing the Measure of Acceptance of the Theory of Evolution (hereafter referred to as "MATE score") showed some definitive results. The median MATE score for the sample was high at 96.5. The range for the data was 62. The data produced a negative value of -3.65 for the Pearson measure of skewness, indicating a high degree of skewness toward the high end of the scale for the MATE score. Percentile ranks confirmed this. Scores at the 25th, 50th and 75th percentiles were 89, 96.5 and 100, respectively.

Cronk (2006) recommends the use of median and range as descriptors for negatively skewed data to help negate the effect of outliers on the identification of data trends. Figure 1 is a boxplot of the score data, which shows the degree to which the data are skewed to the right (high) end, and the significant difference of the single outlying score of 38 to the remainder of the scores.

Figure 1. Boxplot of MATE Scores.



The MATE instrument produces a score ranging from 20-100, where 100 is the highest score possible. The median was selected as an alternative to the mean score as a measure of central tendency due to the large range of 62 and the negative value of Pearson's measure of skewness. The median score of section one of the survey was 96.5. This score indicates a very high level of acceptance of the theory of evolution by the majority of the respondents.

5.2 Categorical Results

Measuring the central tendencies of categorical data require the use of the mode of the data to show which responses to questions are the most common. The demo-

graphic questions in the survey mailed to respondents are categorical in nature, and thus the mode was utilized as a descriptive statistic to describe the central tendency of the data. The data from the categorical demographic questions are summarized in Table 2.

Table 2 shows the characteristics of the most common science teacher in the FNSBSD. If one were to visit the classroom of a high school science teacher in the FNSBSD, one would likely find a female teacher with a Bachelor of Science degree and endorsement in biology. Her education will have involved over 40 credit hours in biology and included a course in evolution and the nature of science. This teacher will have spent the majority of her years (15-20 years experience) teaching at the high school level. Strangely, however, the most common amount of class-time spent devoted to the teaching of evolution in the FNSBSD is only 0 to 3 days.

Table 2

Most Common Responses to Categorical Survey Items

Variable	Response	Variable	Response
Gender:	Female	Credit Hrs in Biology:	40+
Level of Degree:	B. S.	Course in Evolution?	Yes
Grade Level Taught:	9-12	Course in Nature of Science?	Yes
Years of Experience:	15-20	Instructional Days w/ Evolution	0-3
Endorsement:	Biology		

5.3 Categorical Comparisons

This section lists the results of some comparisons made between the MATE score and certain variables from the categorical data. Table 3 summarizes the median MATE score for the survey item which asks respondents to indicate their level of degree attainment. Table 4 summarizes the comparison of median MATE score and the number of instructional days spent on the study of evolution in the classroom.

Table 3

Degree Levels and Median MATE Score

Degree	Score	n	Degree	Score	n
B. A.	100	1	M. Ed.*	91.5	10
B. S.	95	12	M. S.	99	7
M. A.	92	6	Ph. D.	93	2

The categories chosen by the individual with the lowest MATE score are starred (*) in both Table 3 and Table 4. Overall no clear pattern is evident in this comparison, though it is interesting to note 25 of the 38 respondents hold graduate level degrees.

Table 4

Days Spent on Evolution and Median MATE Score

Days	Score	n	Days	Score	n
0-3	93	14	8-14*	92	7
4-7	99	9	15+	100	8

In Table 4, it is interesting to note that, in spite of the recommendations supported by the literature regarding the central treatment evolution should receive in the science classroom, over 1/3 of the respondents devote a minor amount of class-time to the teaching of evolution. This reflects national trends as reported in the literature. The reader is reminded that MATE scores reported in Tables 3 and 4 are medians and not means, and thus ameliorate the effects the low outlier might have on overall score for this category.

5.4 Qualitative results

The qualitative data were the result of survey respondents using a space for comments and questions provided on the back cover of the survey. Table 5 offers a summary of the qualitative comments and the MATE scores of those respondents that included comments with their survey. The complete text of the comments are provided in Table A-1 of the Appendix.

The data were scored for "attitude" based on researcher perceptions of the attitude of the written comments on the back cover of the booklet. Three different classifications were made: positive, negative and indifferent. Teachers were scored as being "positive" if their comments showed they possessed an understanding of the debate and appeared to support evolution independent of their MATE score. One comment was clearly positive: "Students need to hear about evolution in ALL science classes, not just introductory biology courses. I hope chemistry, physics and earth science teachers are incorporating this unifying theory in their curriculum."

Comments received a score of "negative" if the respondent exhibited an understanding of the debate but seems to be tired of it, or fails to acknowledge it in class to avoid trouble. Classroom troubles can include becoming a target of parents that object to evolution as contrary to their beliefs, or even students that are resistant to instruction in general and may use the debate as a way of avoiding an assignment by claiming offense. This comment has clear negative tones:

> I believe that textbooks are totally biased toward evolution and do not provide students the opportunity to consider other facts available. I just completed a unit on origin of life and evolution in which I had students research and write a paper. I allowed them the academic freedom to choose either evolution theory or creation theory. Between 30 and 40% chose creation as their theory to investigate and defend. Our curriculum is not supportive of any possible theory other than evolution. This is a disservice to young adults who are seeking to learn. Mr. Shier, Please note that there <u>are</u> experienced teachers with advanced degrees and training, who consider creative design to be plausible as well as backed by solid, observable fact.

It is clear this respondent has strong negative feelings about the debate and seems frustrated about the prospects for teaching alternative theories in the current environment.

In general, the MATE scores of those respondents offering comments mirror the skewed characteristic of the overall data. The MATE score of 38 in Table 5 with the asterisk (*) is the lowest score of the survey and the only outlier. The next lowest score

was a 79 and within 10 points of the score on the 25th percentile. The data are scored with regard to the overall tone of the comments and the perceived nature of the actions taken or suggested by the author of the comments.

Table 5

Scoring Results of the Qualitative Comment Data

Score	Attitude	Action	Score	Attitude	Action
96	negative	proactive	100	positive	proactive
100	negative	proactive	97	negative	proactive
100	positive	proactive	38*	negative	frustrated
100	negative	indifferent	89	indifferent	proactive
91	positive	proactive			

Note. The score of 38 is the lowest MATE score of the respondents.

5.5 Summary of results

Both the quantitative and qualitative results show an overall high level of acceptance of the theory of evolution by the majority of the respondents to the survey. A median score of 96.5 was calculated for respondents completing the Measure of Acceptance of the Theory of Evolution (MATE) portion of the survey (Part 1). Summaries of the modes for the categorical data about the characteristics of the teachers in the Fairbanks Northstar Borough School District show the most common teacher in the FNSBSD to be a female high school teacher with 15 to 20 years of experience in teaching and a bachelor of science degree with a matching endorsement in biology. This teacher

has included courses in both the nature of science and evolutionary biology during the accumulation of over 40 credit hours in biology. It is remarkable to note, however, that the most common response to an item asking for the approximate number of days spent on evolution was "0 to 3 days."

6. SUMMARY

6.1 Quantitative Summary

The literature shows how the effect of the debate between evolution and creation on the classroom in general and on science teachers in particular is poorly understood. Previous studies have tried to explore the interaction of various, sometimes unrelated, variables with results that are incomplete or confounded. The purpose of the Measure of Acceptance of the Theory of Evolution (MATE) instrument developed and validated by researchers Rutledge and Warden (1999) was to side-step the difficulties encountered by other researchers and get to the heart of the problem by assessing the level to which science teachers accept the theory of evolution as a valid explanation of the origins and diversity of life on Earth. Once this factor is clear, the interaction of other variables (attitude, personal belief, influence of outside pressures, etc.) can be more clearly understood.

The object of this study was to accurately assess the level to which the science teachers of the FNSBSD accept the theory of evolution as a valid explanation of the origins and diversity of life on Earth. The MATE was implemented as part of a survey which included items requesting basic demographic information, such as teaching endorsement, credit hours taken, and years of experience in teaching. Fifty-nine science teachers of the FNSBSD were selected through district records to take part in the survey by mail. Thirty-eight teachers (64.4%) elected to participate and returned completed surveys.

The MATE scores of the participants were in general very high with a median score of 96.5 out of 100. The lowest score of 38 was classified as an outlier, because all of the remaining scores were at 79 or above. Thirteen (34%) of the respondents achieved a score of 100 out of 100, the highest possible score on the MATE. These results indicate a high level of acceptance of the theory of evolution by the science teachers of the FNSBSD.

The most common choices made in the demographic section of the survey indicate the teachers in the FNSBSD appear to be highly qualified to deliver quality instruction in biology in general and evolution in particular. The most common responses to these questions indicate the most frequent science teacher in the FNSBSD is female, holds a Bachelor of Science degree and an endorsement in biology, has 15-20 years of experience, and has completed over forty credit hours in biology. Academic work completed by respondents includes courses in the nature of science and in evolution. In light of this apparent strong acceptance of evolutionary theory and qualifications, one might find it reasonable to expect that evolution will receive a strong, thorough treatment in classroom instruction. However, when teachers were asked how many instructional days were spent on evolution in the classroom, the most common response was "0-3 days".

6.2 Qualitative Summary

Qualitative data were collected as optional, free-form, open-ended comments on the back cover of the survey booklet sent to respondents. The data were thematically scored following the recommendations of Creswell (2006) for apparent attitude, and for

"action" they take regarding the debate. Overall, respondents exhibited a negative attitude toward the debate, but as teachers, seemed to feel proactively empowered to do something about it. Many respondents offered ideas and aspirations about what they hoped teachers were doing in classes or how they themselves addressed the issue during instruction. One qualitative response (that of the lowest, outlying MATE score) expressed frustration with strong language against the FNSBSD curriculum and textbooks, concerned that the lack of an alternative [theory] was stifling and short-changing our students.

7. DISCUSSION

7.1 Return Rate

Fifty-nine surveys were mailed to potential respondents at their home mailing addresses. Thirty-eight respondents returned completed surveys, for a return rate of 64.4%. This is a return rate higher than anticipated and may be due to several factors. I am a professional colleague of the members of the sample population. Seeing my name associated with survey materials may have been an incentive to respond. The personal feelings of the respondent toward the importance of the issue of evolution in the schools may also have played a part in persuading participation in the survey.

The unique characteristics of life in Interior Alaska may also have played a role in the high rate of return. Dillman (2000) relates an experience reading research of an investigator in Alaska that also achieved a response rate in a percent range of the low 60's. When Dillman asked the investigator why the response rate was so high, the investigator replied the long, dark, cold winters and the infrequent trips to the post office to retrieve mail helped ensure that mail was always answered. These reasons may have played a part in the high rate of return experienced by this study.

7.2 Discussion of the Quantitative Data

The results of scoring the MATE instrument as completed by the respondents of the FNSBSD study indicate a high level of acceptance of the theory of evolution by the majority of the science teachers in the FNSBSD. The high median score of 96.5 is only

3.5 points from the maximum score of 100. The range of scores (excluding the outlier of 38) is 21.

Some scores occur more frequently than others. The most common MATE score received by respondents was 100 (n=13), while the two lowest scores were 38 and 79. This variance in scores may be due to a lower level of acceptance of some of the aspects of evolutionary theory by some of the respondents. It is likely that MATE scores received by respondents will be influenced by where respondents classify themselves on the creation/evolution continuum described by Scott (2004).

To review, this continuum attempts to sort individual belief regarding the explanation of the origin and diversity of life on Earth with regard to causation: natural (atheistic) or supernatural (theistic). Scott describes theists as those individuals or groups who have characteristics ranging from very conservative adherence to a literal reading of the Old Testament to believing that God creates through methods that are indistinguishable from natural causation.

The view opposite of the conservative theistic view (fundamentalist) is a view that excludes the possibility of the supernatural and is atheistic. This group accepts a fully naturalistic view of the origin of life and assigns beliefs of meaning and purpose to nature in terms of nature. Respondents classifying themselves as liberal theists or atheists would tend to have a higher MATE score indicating a higher level of acceptance of the theory of evolution than those classifying themselves as conservative theists. The database con-

tains a large number of scores indicating a very high level of acceptance as shown by the median score of 96.5.

The large number of high scores may indicate teachers in the FNSBSD approach the subject of evolution in the classroom in a manner supported by the literature. The ideal educational situation is one in which the teacher removes the subject of evolution from the debate altogether (at least in the science classroom) by removing the "why" from the discussion. This is because evolution is a scientific explanation that seeks to describe the natural world in terms of nature. It does not assign meaning or value to any aspect of this explanation, but instead limits itself to explaining how things happen, and therefore does not require any references to God or the supernatural. This approach is often referred to as the "method of science" or "methodological naturalism" as detailed above.

Variance in MATE score may also be due to the wording of individual survey items. The MATE instrument was not meant to give an exhaustive treatment of all aspects of evolutionary theory, but instead to be a compromise between length and adequate coverage to all aspects of the theory. This characteristic of the survey may result in individual survey items worded with less precision than may otherwise be necessary to ease the concerns of participants, and may have resulted in a score indicating a moderate level of acceptance.

7.3 Discussion of the Categorical Data

The survey items in section two of the questionnaire were included in an effort to complete comparisons between MATE score and different teacher characteristics, such as experience or instructional days devoted to evolution. No clear pattern exists with regard to MATE score and most of the items included in section 2. In particular, the distribution of the number and level of academic degrees obtained by the respondents give no clear picture about level of acceptance increasing with degree attainment.

One comparison did yield some interesting results. Table 6 summarizes the comparison of median MATE score to the number of days spent on evolution. Median scores were calculated for each choice of "number of days" on the survey item. One interesting piece of information made clear here is the portion of the respondents who spend one week or less on evolution, in spite of a median score in the 90's for that group. This is contradictory to the suggestions made in the literature that evolution be treated as the underlying framework in all biology classes. This may be due to several factors, including the suggestions made by Tatina (1989): a) Evolution is a complex topic that is challenging to teach and learn. Teachers avoid it because they are not comfortable with the subject or feel it will be too challenging for their students to master. b) Evolution is not included in teacher curricular decisions because it is not believed. c) Evolution is not universal in high school science because it offends religious beliefs, and d) There is no pressure to include it (pp. 278-279).

Fear of becoming a target of supporters of creationism may play a part in the few number of days devoted to evolution in the classroom. There are some regions of the FNSBSD in which the students may be more resistant to learning evolution than others. This researcher asked one teacher working at a school serving students from theologically conservative homes how she handled the subject of evolution in class. She shared that she did not use the "E-word" at all during the class, and instead found softer euphemisms that she hoped would be less offensive.

7.4 Discussion of the Qualitative Data

Written responses were given by 11 of the 38 respondents (29%) who elected to share "comments or concerns" on the blank back cover of the survey booklet. These qualitative data were thematically scored according to the recommendations of Creswell (2005) for overall "attitude" (positive or negative) and "action" (suggestions for dealing with the debate in the classroom).

Not all of the respondents chose to offer comments on the back cover of the survey. This may be because it was worded to be optional. The "item" consisted of a short phrase at the top of the back cover of the booklet. It read: "Feel free to share any comments or concerns you have here:". This is different from other items in the survey which were worded in such a way so as to appear as more of a requirement of the respondent than an option.

The teachers that responded in general shared both positive and negative attitudes toward the debate. The period of time just prior to when the survey was implemented

coincided with an upswing in the number of news stories about the debate between evolution and creation. This may have influenced the tone of the writing and the researcher's perception on whether the comments offered were positive or negative in nature. Eight years of personal teaching experience has also shown that a teacher's energy level can change markedly throughout the day. These surveys were sent to home addresses, and therefore were likely completed at home, after a long day in the classroom. This may have affected the demeanor of the teacher completing the survey.

The surveys were mailed to any teacher in the FNSBSD teaching one or more sections of any academic science, including physics, chemistry and earth science. Some of the commentaries from these teachers were, in general, indifferent about the debate because they felt it really did not concern them. This is an attitude contradictory to that of the literature, which supports a central role for evolution (as change over time) in the related sciences of chemistry, earth science, and cosmology. These surveys received a qualitative score of "indifferent" with regard to attitude. It is possible opportunities in professional development could help change this perception.

The theme of "action" was defined as "the nature of the respondent's suggestions to alleviate the effects of the debate in the classroom" and were classified as "proactive" or "frustrated". Most teachers took a "proactive" stance with regard to the debate by sharing their hopes and suggestions for classroom discussion on evolution. The proactive responses may have a correlation with the overall high MATE score exhibited by the majority of the respondents and reflect a sophisticated understanding of evolution and the

nature of science, coupled with a high degree of familiarity with biology as a content area. In other words, teachers that understand the nature of science and evolution have a high MATE score and a proactive outlook on the debate as a whole.

The single score of "frustrated" in the qualitative database corresponded with the lowest, outlying MATE score of 38. This individual shared disgust with the treatment textbooks gave explanations for the origins of life and the dearth of opportunities for students to explore alternative theories. In an effort to allow students the opportunities that are absent in the current FNSBSD curriculum, this teacher allowed students to choose evolution or creation to investigate and defend. I was urged as a researcher to realize there were experienced teachers with advanced degrees and training who supported "creative design" as a plausible and well-supported fact. I thought it was interesting to note that this teacher chose "Master of Education" for the survey item asking for the highest level of degree attained. This is an "advanced degree" certainly, but not a degree that necessarily emphasizes the best practices of science teaching.

7.5 Suggestions for Future Research

The presence of this single, outlying score among those who chose to participate in this study points toward a high likelihood of other teachers in the FNSBSD with similar attitudes and frustrations toward the debate. In addition, the overall tendency for the majority of teachers to devote less than two weeks of instructional time to evolution points toward some basic misunderstanding on the part of instructional staff about evolutionary theory and the role it should be playing in the science classroom. It is evident

there are factors at work among the science teachers of the FNSBSD that result in the theory of evolution failing to receive the central treatment in classrooms as supported by the literature.

The MATE instrument was designed by its developers to assess the level to which respondents accept the theory of evolution as a valid explanation for the origins and diversity of life on Earth. This study has shown the science teachers of the FNSBSD have an overall high level of acceptance of the theory of evolution. The next step is to attempt to determine what influence other factors may have in determining what are the causes of some of the particular characteristics of the population of teachers in the FNSBSD brought forth by this study.

The MATE instrument was originally developed with the purpose of determining the level to which a respondent accepts evolution. Evolution is unique in that it explains nature in terms of nature, without any reference to the supernatural for meaning or purpose. Evolution is a non-theistic (which is different from atheistic) theory. This may mean that a person with a low MATE score (low level of acceptance of evolution) may tend toward theological conservatism, due in part to an inability, or unwillingness, to switch epistemological lenses.

Respondents scoring in the 90 to 100 range are more enigmatic. High MATE scores could be due to a respondent possessing a well-developed ability to switch epistemological lenses. The statements on the survey instrument could then be judged in the light of scientific evidence supporting an ancient earth and extinct fossil forms, thus pro-

ducing a high score. Alternatively, respondents with a high score may be metaphysical naturalists, whom the literature states would obtain a high score by disagreeing with statements in the survey that support a creationist argument.

A survey item attempting to determine where on the evolution/creation continuum respondents consider themselves to be could give a clearer picture of the reason for a high or low MATE score. For example, a person receiving a MATE score of 100 may be of two types: either this person is an atheist and has a world view resembling that of metaphysical naturalism (MPN), or this person fully understands the nature of science and realizes that science (as methodological naturalism or MN) is a way of knowing that has no relationship to religion and thus is able to allow his or her religious beliefs to co-exist with the claims made by science. This could be instructive for consumers of research seeking to plan opportunities of professional development for educational staff.

The data generated for this study were not conducive to statistical analysis, which limited the analysis to discussions of the descriptive statistics. Future measures of significance might be better facilitated through minor changes and additions to the structure of the survey. For example, subsequent research conducted by Rutledge and Warden (2000) involved the inclusion of a single question item asking the respondent to choose whether or not they accepted evolution. This resulted in bivariate data suitable for chi-square analysis.

Many authors agree the debate between evolution and creation is fundamentally a sociocultural phenomenon and not a scientific one. This is made clear in the persistent

attempts of creationist authors to conflate MN and MPN, effectively erasing the division between the two (Alters & Alters, 2001; Gould, 1999; Johnson, 1995; Pennock, 2000). Qualitative data and analyses to better understand this fact of the debate could be accomplished through the inclusion of more open-ended response items on the survey, and the incorporation of focus groups as a portion of the research could answer many of the questions that are inadequately described by the data generated here.

Other means of delving more deeply in to the characteristics of classrooms on the front lines of this debate might include recording observations of classes before, during and after evolution is covered in class. Using the MATE or a similar instrument with students (and parents) may produce interesting comparisons with the teacher in a given classroom. Curricular analyses could also shed some light on reasons for teachers failing to give evolution a central role in the classroom; overcrowded classes and overburdened teachers could limit innovation on the part of the teacher to modify curricula in a manner supported by the literature.

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APPENDIX

Table A-1

Complete comments written on the back cover of the survey booklet

Score	Comments
96	"In my experience, there are very few "middle of the road" students - those open to discussion. About 95% already accept evolution and don't understand what the fuss is about, and about 5% don't even want to hear it based on religious values and elect to sit out of class. In all, the BIG question for them is alternative ideas as to how life began in the first place (assuming the "prehistoric soup" idea is the most commonly accepted currently).
100	"Evolution is misunderstood by many who do not understand the scientific process and the body of evidence supporting evolution."
100	"Ques. 15- The definition of humans (Homo sapiens) Are their hominid ancestors of different forms - yes. Ques. 9 - section 2 I teach a unit on Geological history before I teach evolution. It covers the Eras/Periods/Epochs/ dominant life forms/mass extinctions. I included that in my days of instructional time (15+) I'm teaching Evolution starting 1/31 - give me a call. [Name deleted]

Score	Comments
91	"While the discipline I teach rarely presents evolutionary issues, the American Association of Physics Teachers still felt it important to take a stance on the debate. Since 'Evolution' and the 'Creation of the Earth' debate are often tied together in this discussion, they released the following enclosed statement which also reflects my opinion.
13	"Students need to hear about Evolution in ALL science classes, not just introductory biology courses. I hope chemistry, physics, and earth science teachers are incorporating this unifying theory in their curriculum."
97	"- I teach Earth Science, Physical Science, & Physics. - Evolution comes up in E. Sci, but mostly in the context of lessons on fossil records, radiometric dating, and the Big Bang Theory (<--Why?). The students I teach have received much contradictory information on the subject before they get to 9th grade. - The topic seldom comes up in my other science classes."
89	I am not teaching biology at present, however when I have I have spent 8-14 days throughout the year on this topic."
100	"Evolution is not theory it is fact. I teach no evolution because I mostly teach chemistry but inject evolution when possible."

Score	Comments
38	"I believe that textbooks are totally biased toward evolution and do not provide students the opportunity to consider other facts available. I just completed a unit on origin of life and evolution in which I had students research and write a paper. I allowed them the academic freedom to choose either evolution theory or creation theory. Between 30 and 40% chose creation as their theory to investigate and defend. Our curriculum is not supportive of any possible theory other than evolution. This is a disservice to young adults who are seeking to learn. Mr. Shier, Please note that there <u>are</u> experienced teachers with advanced degrees and training, who consider creative design to be plausible as well as backed by solid, observable fact."

Note. The score of 38 is the lowest MATE score obtained in the survey.